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Becoming an Aerospace Engineer: Some Thoughts on the Career Goals and Educational Preparation of AIAA Student Members

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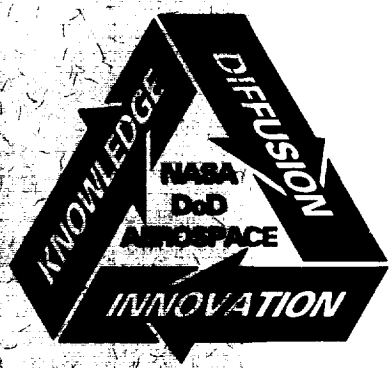

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Becoming an Aerospace Engineer: Some Thoughts on the Career Goals and Educational Preparation of AIAA Student Members

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This article is based on the results of a survey of AIAA Student Members that was conducted during the spring of 1993. The survey is a Phase 3 activity of the NASA/DOD Aerospace Knowledge Diffusion Research Project, which attempts to understand the use and flow of information at the individual, organizational, national, and international levels in the aerospace industry. Phase 3 focuses on the use of information in an academic environment and explores the faculty–student–library information interface.

Similarities and differences between undergraduate and graduate engineering students in the context of two general aspects of educational experience are described in this article. Considered first is the extent to which students differ regarding the factors that led to the choice of a career in aerospace engineering, their current levels of satisfaction with that choice, and career-related goals and objectives. Second, the importance of certain information-use skills for professional success, and the frequency of use and importance of specific information sources and products to meet students' educational needs, are explored.

Survey Demographics

A range of student members of the AIAA was included in the survey, both undergraduate and graduate, male and female. The respondents reflect the demographic composition of the AIAA student membership rather than the demographic composition of all U.S. aerospace engineering students. Of the respondents, 950 were undergraduates and 723 were graduate students. By gender, 1,389 males and 264 females responded: a male-to-female ratio of 5 to 1. The proportion of females was greater among undergraduates (18.2%) than graduate students (13%)

More undergraduate than graduate student respondents were U.S. citizens and spoke English as their native language. The survey results indicate that 84.1% of undergraduates were U.S. citizens and 86.9% spoke English as their first language. About 73% of graduate students were U.S. citizens and about 77% spoke English as their first language.

Presentation of the Data

First we present data about factors that led to the choice of a career in aerospace engineering, students' current levels of satisfaction with the choice, and students' career goals and professional objectives. Next, we provide data about the importance of information-use skills for professional success and the receipt and helpfulness of instruction in these skills. Finally, we offer data on the use and importance of specific information sources and products for meeting students' educational needs.

Table 1 Influence (Importance) of Selected Factors on Career Choice of U.S. Aerospace Engineering Students

Factor	Undergraduate Mean[a]	Undergraduate (*n*)	Graduate Mean[a]	Graduate (*n*)
Your parents encouraged your area of study/major	3.4	879	3.6	666
Other family members encouraged your area of study/major	2.9	853	2.8	636
Teachers encouraged your area of study/major	3.7	884	3.7	664
Career in your major/area of study will lead to financial security	4.6	932	4.3[b]	690
Career in your major/ area of study will provide many rewarding activities	6.3	940	6.1[b]	700
Information on career opportunities available in your major/area of study	4.5	918	4.2[b]	671

[a]Students used seven-point scale (where 7 was highest rating) to evaluate importance of each factor.
[b]$p \leq 0.05$.

Career Choice: Timing, Influences, and Satisfaction

More than half of the undergraduate and graduate students surveyed made their career decisions while in high school. Nearly one-third of the graduate students surveyed decided to pursue a graduate degree after they began college, an indication that a graduate education was chosen independently of the decision to pursue a career in aerospace engineering.

The students were asked what influenced their decisions to pursue careers in aerospace engineering. The data in Table 1 indicate that the opportunity for a rewarding career was the most important factor in career choice among both undergraduate($\bar{X}$ = 6.3) and graduate students ($\bar{X}$ = 6.1).

Other influential factors were achieving financial security in the future and having access to career information about aerospace engineering. A statistical difference exists between undergraduate and graduate students for these three factors. Teachers, parents, and other family members had less influence than other factors on the career decisions of these students.

Although most survey respondents made well-informed decisions about their careers, many respondents are not as happy now about that choice as when they made it. One-fourth of undergraduates and over 30% of graduate students are less happy with their career choices now than when they made their choices (a response that may indicate pessimism about employment prospects in the aerospace industry). This assumption could be tested by comparing the expectations of aerospace engineering students with the expectations of their counterparts in other branches of engineering, such as electrical and chemical engineering.

A survey to test this comparison, done between AIAA student members and University of Illinois engineering students in multiple engineering disciplines, illustrates the effect of employment prospects on current levels of satisfaction with career choice. Overall, Illinois engineering students were happier than AIAA student members with their career choices. Thus the assumption that aerospace engineering students are concerned about employment conditions and are not as happy with their career choices as are their fellow students in other engineering disciplines is supported.

Students who made a career choice early or with access to the best information about a career in aerospace engineering tend to be happiest with their decisions. The students closest to entering the job market—seniors and graduate students—are the least happy with their career choices. Undergraduates who made their decisions in elementary school—those who always thought they would be engineers—or after they were in college—those who might have the best knowledge about careers—are most pleased with their choices. The data indicate a strong correlation between the timing of career choice, the factors influencing career choice, and students' satisfaction with the choice.

Once students have decided to become aerospace engineers, they formulate their career goals and professional aspirations. Survey respondents were asked to indicate the importance of 15 career goals and aspirations, which were broadly grouped into engineering, science, and management career paths. Table 2 shows the student responses.

For both undergraduate and graduate students, engineering-oriented career goals and aspirations—exploring new technology or systems ($\bar{X}$ = 6.3), working on complex technical problems ($\bar{X}$ = 5.7/5.9), learning new technical knowledge ($\bar{X}$ = 5.9), and utilizing the latest theoretical results ($\bar{X}$ = 5.6/5.5)—were most important. For the AIAA students, developing a strong reputation as an authority in the field (a science-oriented career goal or aspiration) or becoming a technical leader of others (a management-oriented career goal or aspiration) was not as important. However, graduate students were more con-

cerned than were undergraduate students about enhancing their professional reputations. Presenting conference papers, publishing articles, and developing a reputation for technical contributions inside and outside the organization appear to be integral elements of graduate students' career goals and aspirations.

Information-Use Skills: Importance, Instruction, and Helpfulness

The production, transfer, and use of information is a significant component of engineering work. Employers expect engineering graduates who enter the world of work to possess certain information-use skills that enable entry-level engineers to be productive immediately upon being hired. A survey of the literature, and input from engineering professionals, produced a list of six fundamental information-use skills that entry-level engineers should possess. Respondents were asked to rate the importance of these six skills for professional success, using a seven-point scale, where 7 was the highest rating. Their responses appear in Table 3a.

For both undergraduate and graduate engineering students, using computer, communication, and information technology; communicating technical information orally and in writing; and understanding how to use engineering/scientific information resources are the most important information-use skills needed for professional success. With two exceptions (communicating orally and in writing), undergraduate engineering students attributed a higher level of importance to the information-use skills than did their graduate counterparts.

Survey respondents were asked if they had received instruction in the six information-use skills and to rate the helpfulness of the instruction. Their responses appear in Table 3b. In general, more undergraduate than graduate engineering students had received instruction in the skills that were rated. Approximately 87% of the undergraduate engineering students (and 78% of the graduate engineering students) had received instruction in using computer, communication, and information technology. More than 70% of both groups had received instruction in technical writing/communication. Approximately 69% of the undergraduates (and 56% of the graduate students) had received instruction in using engineering/scientific information resources.

Table 2 Career Goals (Aspirations) of U.S. Aerospace Engineering Students

Goal	Undergraduate Mean[a]	Undergraduate (n)	Graduate Mean[a]	Graduate (n)
Engineering				
Opportunity to explore new ideas about technology or systems	6.3	942	6.3	700
Advance to high-level staff technical positions	5.4	928	5.4	695
Opportunity to work on complex technical problems	5.7	946	5.9[b]	702
Work on projects that utilize latest theoretical results in your specialty	5.6	943	5.5[b]	699
Work on projects that require learning new technical knowledge	5.9	946	5.9	703
Science				
Establish reputation outside your organization as authority in your field	5.3	938	5.4	697
Receive patents for your ideas	4.5	923	4.1[b]	686
Publish articles in technical journals	4.5	937	5.2[b]	697
Communicate your ideas to others in your profession through papers delivered at professional society meetings	4.8	941	5.2[b]	704
Be evaluated on basis of your technical contributions	5.3	930	5.5[b]	700
Management				
Become manager or director in your line of work	5.1	928	4.7[b]	690
Plan and coordinate work of others	5.1	932	4.8[b]	688
Advance to policy-making position in management	4.7	924	4.5[b]	688
Plan projects and make decision affecting organization	5.4	937	5.2[b]	693
Be technical leader of group of less experienced professionals	5.3	936	5.1[b]	692

[a]Students used seven-point scale (where 7 was highest rating) to evaluate importance of each goal.
[b]$p \leq 0.05$.

Using a seven-point scale, where 7 was the highest rating, survey respondents were asked to evaluate the helpfulness of the instruction they had received. Overall, both groups rated the instruction helpful. Both groups gave the highest rating to instruction in the use of computer, communication, and information technology, although a significant difference exists in the rating given by undergraduate and graduate engineering students. Both groups also rated highly their instruction in technical writing/communication, although a significant difference exists here, as well, in the rating given by undergraduate and graduate students.

Table 3a Importance of Information Skills for Professional Success

	IMPORTANCE			
	Undergraduate		Graduate	
Skill	Mean[a]	(*n*)	Mean[a]	(*n*)
Communicating technical information in writing	6.3	942	6.4[b]	702
Communicating technical information orally	6.3	942	6.3	701
Knowledge/understanding engineering/ scientific information resources	6.3	936	6.1[b]	702
Searching electronic databases	5.6	919	5.3[b]	697
Using library	5.8	938	5.7[b]	701
Using computer, communication, and information technology	6.6	943	6.5[b]	701

[a]Students used seven-point scale (where 7 was highest rating) to evaluate importance of each skill.
[b]$p \leq 0.05$.

Use and Importance of Information Sources and Products

Engineering has been described as knowledge-intensive work that requires the use of a variety of information sources and products. The information sources may be individuals or specific resources within which knowledge resides or that point to the location of the needed information. Given a list of specific information sources and products, AIAA student survey respondents were asked to evaluate their use and importance, using five- and seven-point scales respectively. Table 4 shows their responses.

Both groups were given a list of five information sources: your personal collection of information, other students, faculty, library, and librarian. Both groups made the greatest use of personal collections of information. For additional sources of information, undergraduates also consulted other students, faculty, and the library in that order; graduate students relied on the library, faculty,

Table 3b Information-Skill Instruction Received and Helpfulness of Instruction

	RECEIVED				HELPFULNESS			
	Undergraduate		Graduate		Undergraduate		Graduate	
Skill Instruction	Percent	(*n*)	Percent	(*n*)	Mean[a]	(*n*)	Mean[a]	(*n*)
Technical writing/communicating	73.4	692	71.1	500	5.6	680	5.3[b]	509
Speech/oral communication	64.8	611	58.0	408	5.5	606	5.4	427
Using library containing engineering/scientific information resources	64.5	608	53.8	378	5.2	604	5.0	381
Using engineering/scientific information resources	68.7	648	55.8	392	5.3	648	5.2	395
Searching electronic (bibliographic) databases	55.2	521	43.0	302	5.0	533	4.9	318
Using computer, communication, and information technology	87.1	821	77.9	547	6.0	808	5.8[b]	543

[a]Students used seven-point scale (where 7 was highest rating) to evaluate helpfulness of skill instruction.
[b]$p \leq 0.05$.

Table 4 Frequency of Use and Importance of Sources and Products Used to Meet Information Needs of U.S. Aerospace Engineering Students

	USE				IMPORTANCE			
	Undergraduate		Graduate		Undergraduate		Graduate	
Source and Product	Mean[a]	(*n*)	Mean[a]	(*n*)	Mean[a]	(*n*)	Mean[a]	(*n*)
Source								
Your personal collection of information	3.9	935	4.1[b]	699	5.8	938	6.1[b]	697
Other students	3.4	936	3.2[b]	697	4.8	936	4.4[b]	697
Faculty members	3.2	935	3.4[b]	697	5.2	938	5.2	698
Library	2.9	932	3.4[b]	697	4.5	935	5.2[b]	697
Librarian	1.8	928	2.0[b]	685	2.6	933	3.0[b]	695
Product								
Textbooks	4.4	937	4.0[b]	697	6.3	926	6.0[b]	694
Handbooks	2.9	936	2.8	693	4.6	925	4.4[b]	689
Journal articles	2.7	935	3.6[b]	698	4.2	924	5.6[b]	695
Technical reports	2.4	933	3.1[b]	695	3.8	922	4.8[b]	693
Conference/meeting papers	2.1	935	3.3[b]	699	3.3	924	5.1[b]	695

[a]Students used five-point scale (where 5 was highest rating) to evaluate use. Students used seven-point scale (where 7 was highest rating) to evaluate importance.
[b]$p \leq 0.05$.

and other students. Neither group made great use of the services of a librarian.

Both groups also were given a list of five information products: textbooks, handbooks, journal articles, technical reports, and conference papers. Both groups reported the greatest use of textbooks. To meet their information product needs, undergraduate students also used, in descending order of importance, handbooks, journal articles, technical reports, and conference papers. Graduate students used, in descending order of importance, journal articles, conference papers, technical reports, and handbooks. Significant differences exist among the use ratings of four of the five information products for both groups.

The respondents also were asked to rate the importance of these same five information sources and products. Personal collections of information and faculty members were rated most important by both groups, followed by other students and the library for undergraduates, and the library and other students for graduate students. Again, neither group placed great importance on the services of a librarian. Textbooks were rated the most important information product by undergraduate and graduate engineering students. Handbooks, journal articles, technical reports, and conference papers followed for undergraduate students, and journal articles, conference papers, technical reports, and handbooks followed for graduate students. As with the use ratings, significant differences exist among the importance ratings of all five information products for both groups.

Concluding Remarks

AIAA student members seem relatively happy with the choice of a career in aerospace engineering, despite pessimism about the industry's future. Happiness with this career choice appears to be directly related to the timing of the decision, the quality of information available about aerospace engineering careers, and perceived opportunities for professional growth and career satisfaction.

The data also indicate that aerospace engineering students are well aware of their need for information-use skills that will enable them to be productive members of their profession once they are hired. Most of the undergraduate and graduate engineering students in this survey have received instruction in these skills and report that the instruction was helpful. The higher level of importance that undergraduates accord these information-use skills may be attributable to the fact that more undergraduate than graduate students have received formal instruction in information-use skills. A perceived immediate need for these skills may also account for the higher importance rating accorded by undergraduates who expect to enter the workforce upon graduation.